

ESL-TR-1979-301

**ENERGY CONSUMPTION AND DEMAND,
EDWARDS AIR FORCE BASE**

TRW Incorporated
Energy Systems Group
One Space Park
Redondo Beach, CA 90278

Contract No. N68305-79-C-0007

November 1979

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**ENGINEERING & SERVICES LABORATORY
AIR FORCE ENGINEERING & SERVICES CENTER
TYNDALL AIR FORCE BASE, FLORIDA 32403**

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14. ABSTRACT Energy storage has proven to be effective in load leveling for utilities and for making feasible the switch to inconstant energy sources such as solar and wind in applications requiring nearly constant sources of power. To date, energy storage has not been used in large measure on military bases as a technique for improving energy use efficiency. To assess the potential for energy storage at a military base, the U.S. Air Force has selected Edwards Air Force Base at Edwards, CA as a candidate energy storage study site. This report is the result of the first phase of that study which has three major objectives: 1 - Determining the historical energy use patterns at the study site 2 - Evaluate specific energy storage techniques at the study site 3 - Develop a handbook that will assist personnel at other bases in evaluating energy storage applications at their locations Energy use data collected at Edwards AFB is tabulated for the period of July 1977 through June 1979. All purchases energy except flightline and transportation fuels are included in the report. Data is presented as monthly totals except for electrical energy usage which is also presented in selected hourly summaries.					
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INTRODUCTION

Energy storage has proven to be effective in load leveling for utilities and for making feasible the switch to inconstant energy sources such as solar and wind in applications requiring nearly constant sources of power. To date, energy storage has not been used in large measure on military bases as a technique for improving energy use efficiency.

To assess the potential for energy storage at a military base, the U.S. Air Force has selected Edwards Air Force Base, Edwards, California as a candidate energy storage study site. This report is the result of the first phase of that study which has three major objectives:

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- Develop a handbook that will assist personnel at other bases in evaluating energy storage applications at their locations.

Energy use data collected at Edwards Air Force Base is tabulated for the period of July 1977 through June 1979. All purchased energy except flightline and transportation fuels are included in the report. Data is presented as monthly totals except for electrical energy usage which is also presented in selected hourly summaries.

TOTAL ENERGY CONSUMPTION

Composite energy use figures for electricity and natural gas for the period of July 1977 through June 1979 are given in Table 1. Propane and fuel oil data is listed for the months of October 1978 through June 1979, the only months for which records are available.

Seasonal demands are evident for the primary base energy sources of electricity and gas. Summer air conditioning loads drive electricity consumption to the highest levels beginning in June and continuing well into the fall.

Natural gas, used primarily for space heating, has a demand pattern that peaks sharply in the winter months of December through February and drops to low levels in the summer months when it is used for domestic hot water generation.

No trends in energy use over the reporting period are discernible for the primary energy sources suggesting that energy demand is presently driven by heating and cooling degree days only. Energy conservation programs implemented prior to the study period have apparently stabilized energy demands at their present levels. New measures being considered offer the potential of reducing overall consumption; energy storage can assist in controlling short term demand and in the shift to alternate fuels.

EDWARDS AIRFORCE BASE

Table 1. PURCHASED ENERGY JULY 1977-JUNE 1979

		Electricity KWH	Natural Gas MCF	Propane Gallons	Fuel Oil Gallons
July	1977	10,492,000	17,731	-	-
August	1977	10,678,000	17,568	-	-
September	1977	9,538,000	17,831	-	-
October	1977	8,236,000	30,526	-	-
November	1977	9,060,000	32,931	-	-
December	1977	9,590,800	76,592	-	-
January	1978	9,370,400	89,908	-	-
February	1978	8,620,000	75,160	-	-
March	1978	9,290,400	62,176	-	-
April	1978	8,009,200	57,253	-	-
May	1978	8,626,000	26,410	-	-
June	1978	9,162,000	17,693	-	-
July	1978	10,343,600	17,198	-	-
August	1978	9,702,400	17,382	-	-
September	1978	9,006,400	18,922	-	-
October	1978	8,272,400	28,130	3,816	1,000
November	1978	9,075,200	73,726	7,500	11,649
December	1978	9,944,400	103,528	13,300	38,251
January	1979	9,751,600	106,891	13,737	28,721
February	1979	9,712,000	85,476	9,411	40,202
March	1979	9,212,400	67,992	8,101	12,296
April	1979	8,354,400	44,977	5,200	4,243
May	1979	8,486,400	23,514	2,856	-
June	1979	10,058,400	17,710	-	-

ELECTRICAL ENERGY

ELECTRICAL ENERGY

Table 2 is a composite of the electrical energy consumption and demand for the study period of July 1977 through June 1979.

Beginning in November of 1977, the base was switched from the fairly common energy plus demand plus fuel adjust type of rate schedule to a time-of-day rate schedule for both energy consumption and demand.

The rate schedule for Edwards (included as an appendix to this report) divides the billing into three separate periods every day.

- On-Peak - During this period, the utility is normally experiencing its greatest demand for electricity. The rate schedule is designed to encourage a shift of demand out of this period by charging relatively high rates for both energy (KWH) and demand (KWD) in this interval.
- Mid-Peak - The hours on either side of the peak demand period where demand on the utility is moderately high. The rates during this period are reduced compared to peak rates for both energy and demand.
- Off-Peak - The period of lowest demand on the utility. The rate schedule attempts to encourage a shift to this period of the day by setting energy charges at the lowest level and eliminating completely the charges for demand.

The rate schedule definition of "on-peak"

- Winter 5:00 p.m. to 10:00 p.m.
- Summer 12:00 noon to 6:00 p.m.

makes it fairly simple for Edwards to avoid the peak period during the "winter" months of December through May. Heavy air conditioning loads in the summer unfortunately coincide with the summer peak period and consequently impact the utility bills quite heavily during the "summer" months of June through November.

METER #P14-1929
SCHEDULE TOU8

Table 2

ST \$	DEMAND KW MID PEAK	MID COST \$	DEMAND KW OFF PEAK	TOTAL DEMAND COST	TOTAL COST \$
324.80	16608	10,795.20	14544	96,120.00	292,072.00
528.80	14640	9,516.00	12624	85,144.80	250,346.39
964.00	13349	8,673.60	12816	65,637.60	220,966.69
903.20	14064	9,141.60	13344	68,044.80	239,611.39
296.80	14880	9,672.00	14208	71,968.80	248,773.88
993.60	14976	9,734.40	14592	73,728.00	250,375.81
539.20	14976	9,734.40	14112	72,273.60	239,601.40
091.20	14256	3,564.00	13584	27,655.20	227,398.67
147.20	14496	3,624.00	12912	34,771.20	215,918.96
356.80	14784	3,696.80	12864	36,052.80	237,089.12
575.20	16608	4,152.00	15312	38,827.20	263,425.48
078.40	16320	4,080.00	15120	39,158.40	252,880.05
372.80	16060	4,020.00	14352	38,392.80	250,736.38
558.40	15552	3,888.00	13152	36,446.40	234,182.12
385.60	13200	3,300.00	12768	26,685.60	203,485.17
184.00	13152	2,288.00	12672	26,472.00	232,832.93
292.80	14592	3,648.00	14448	27,940.80	214,786.94
897.60	14688	3,672.00	14016	28,569.60	219,617.19
208.00	14304	3,576.00	13728	29,784.00	218,105.19
796.80	14400	3,600.00	14016	28,396.80	207,945.06
EL JUST		MAX DATE	KW TIME		
013.92		10/5	1230		
646.60		9/7	1230		
116.00		8/1	1200		
612.48		7/18	1115		

Energy storage offers a solution to the problem of peak period penalties by permitting the shut-down of power-consuming equipment during these intervals. Phase II of this study will explore the possibilities in detail.

To further depict the electrical energy consumption pattern at Edwards, the consumption figures of Table 2 are presented graphically in Figure 1. The bars at the bottom of the figure show the portion of the monthly total (top curve) that was consumed during on-peak, mid-peak and off-peak hours.

As explained above, "on-peak" consumption is evidently low during the winter months, but climbs during the summer when the definition of on-peak coincides with base peak consumption.

Off-peak energy is shown to be the highest in any given month. At first glance this would appear to be the ideal situation since off-peak energy costs the least per KWH. Actually, the figures suggest a need for increased conservation measures during the night time hours. The off-peak definition of 10:00 p.m. through 8:00 a.m. the next morning coincides with the period of lowest activity on the base, but demand and consumption remain relatively high. Unnecessary night time lighting and space conditioning are typical areas to be addressed in reducing this off-hour load.

To keep the distribution of diurnal consumption in perspective, it is important to refer to the applicable rate schedule definitions for the three daily billing periods. Independent of the month of the year, the off-peak period is a block of ten hours duration, mid-peak is two four-hour blocks on either side of the on-peak hours and on-peak is six hours long.

It might be expected that the sum of on-peak and mid-peak energy, which takes place in a fourteen hour interval, would exceed the off-peak consumption, which covers only a ten hour period. The fact that this is not the case in most months can be attributed to the early start-up of equipment in the morning hours. A large percentage of the first shift energy is consumed prior to 8:00 a.m. and thereby remains in the off-peak column. It is anticipated that management action together with

EDWARDS MAIN BASE ELECTRICAL ENERGY CONSUMPTION

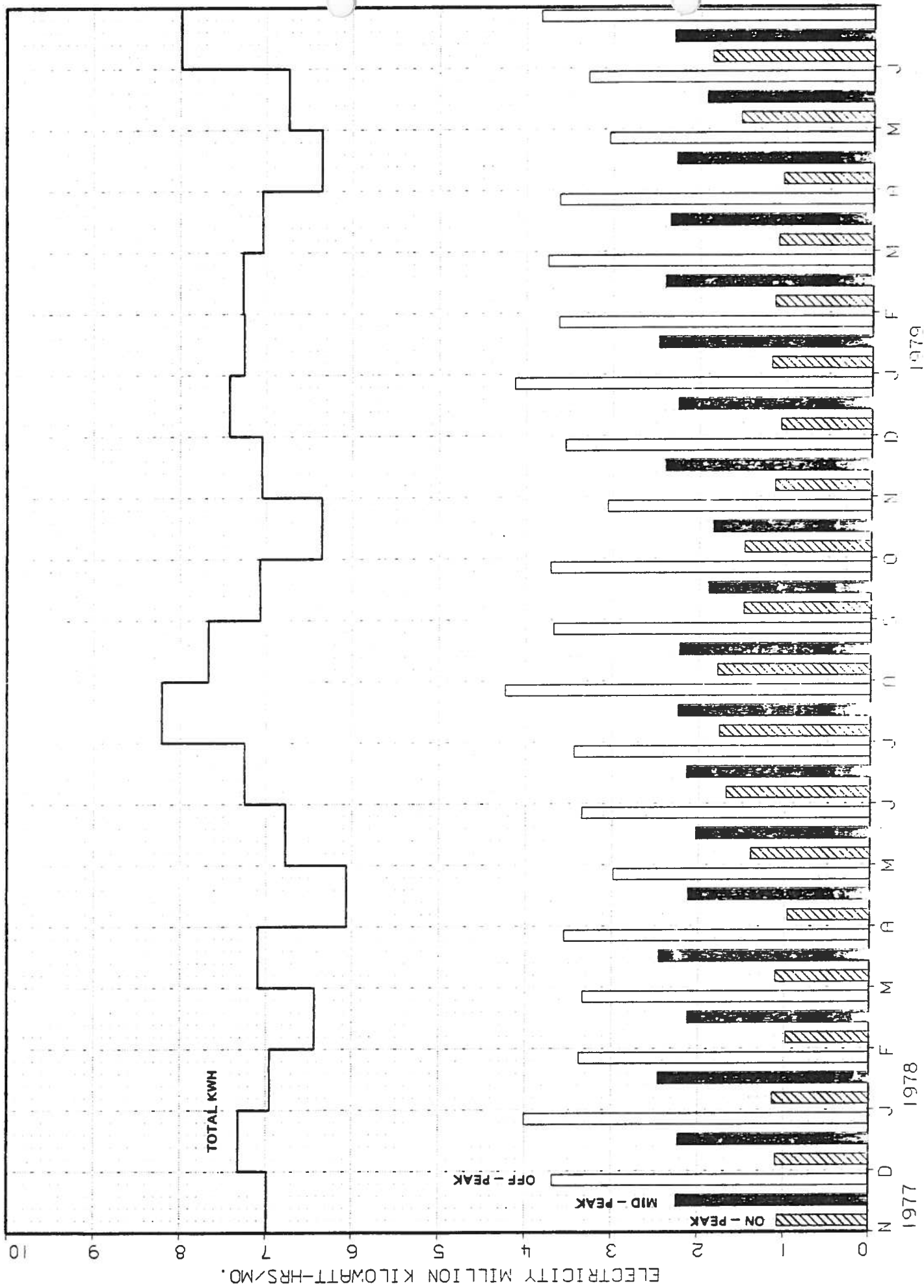
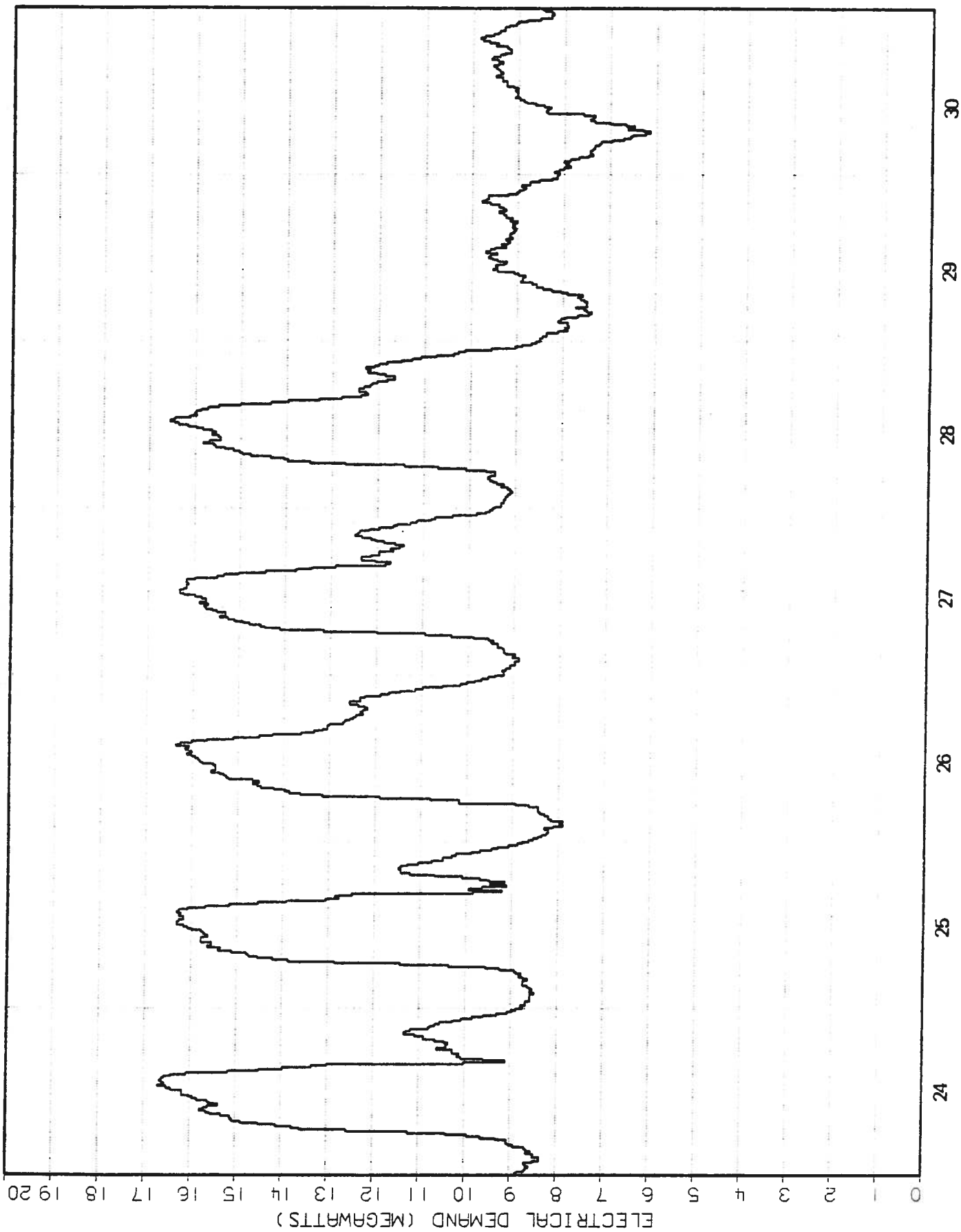


Figure 1

EDWARDS AFB KWD



JULY 1978

Figure 2

energy storage could accentuate that condition to shift an even greater portion of energy consumption to the off-peak (lowest cost) hours.

ROCKET TEST

Table 3 gives the electrical consumption data for the rocket test facility at Edwards. The utility meters this area of the base separately and uses a different rate schedule to determine billing. This schedule is the more conventional energy plus demand-type without time of day penalties/incentives.

The demand charges do offer an incentive to consider energy storage with this billing schedule also. By smoothing out daily demands through the use of stored energy, peak energy demands (and peak demand charges) can be controlled. It is expected that applications for energy storage developed in Phase II of the study for the main base complex will be applicable at the rocket test site but with diminished return due to the differing rate schedules.

BASE HOUSING ELECTRICITY

Table 4 gives the electric energy consumption and demand figures for base housing. The data indicates that all base housing consumes about 10 percent of the total base electricity with highest demand in the winter months.

Energy storage for load management is not expected to yield any economic payback for base housing because of the large number of housing units on the base. However, energy storage for solar energy applications is worthy of consideration in this area of the base.

HOURLY DEMAND--ELECTRICITY

Figure 2 is a plot of data recorded by the utility showing the average demand in each fifteen minute interval for a week in July 1978.

The pattern which begins at midnight on Monday 24 July and ends the following Sunday at midnight, illustrates the daily pattern on electrical consumption and demand.

From a low point in the early morning hours, consumption peaks rapidly during the hours of the first shift, decreases slightly during the lunch break, and then hits the high for the day mid-afternoon when

EDWARDS AIR FORCE BASE

Meter No. P14-1914
Schedule A7

Table 3. ROCKET TEST ELECTRICITY

<u>Date</u>	<u>Total KWH</u>	<u>KWH Cost</u>	<u>Prev. High Demand</u>	<u>Demand KW</u>	<u>Demand Cost</u>	<u>Total Cost</u>	<u>KW Date</u>	<u>Max. Time</u>	<u>Fuel Adjust</u>
5/31 - 7/02 1979	1230000	6,669.00	3680	2900	12,470.00	43,956.24	6/06/79	13:30	27060.00
5/01 - 5/31 1979	1170000	6,327.00	5000	2740	11,782.00	41,683.00	5/29/79	7:30	25740.00
4/02 - 5/01 1979	1230000	6,975.00	5000	3240	13,072.00	45,535.52	4/03/79	9:30	27060.00
3/02 - 4/02 1979	1440000	7,830.00	3680	3420	14,706.00	51,460.76	3/21/79	9:30	31680.00
1/31 - 3/02 1979	1590000	8,415.00	3680	3520	15,136.00	55,523.56	2/14/79	10:00	34980.00
1/02 - 1/31 1979	1530000	8,361.00	3540	3680	15,824.00	54,853.40	1/30/79	8:00	33660.00
12/1 - 1/31 1978	1620000	8,316.00	3640	3300	14,190.00	54,645.05	12/7/79	13:30	24042.00
Rate Change									
10/31 - 12/1 1978	1290000	24,851.04	3660	2920	2,978.00	44,089.38	11/13/79	14:30	18846.90
10/02 - 10/31 1978	1080000	21,296.13	3660	2740	2,816.00	37,673.04	10/4/79	10:30	15778.80
8/31 - 10/2 1978	1200000	23,323.08	3660	2906	2,906.00	41,306.47	9/28/79	9:00	17532.00
8/01 - 8/31 1978	1200000	23,725.95	3660	3100	3,140.00	42,951.31	8/07/79	12:00	17532.00
6/30 - 8/01 1978	1290000	21,484.01	3660	2980	3,032.00	42,612.98	7/24/79	11:30	19102.37
6/01 - 6/30 1978	1140000	19,744.05	3660	2900	2,960.00	40,954.69	6/09/79	7:30	19357.20
5/01 - 6/01 1978	1170000	20,047.08	3660	2840	2,906.00	41,624.76	5/16/79	7:30	19866.60
4/03 - 5/01 1978	1200000	21,372.78	4120	3440	3,446.00	43,651.63	4/07/79	7:30	20376.00
3/01 - 4/03 1978	1440000	24,075.93	4120	3140	3,176.00	50,110.65	3/03/79	8:30	24451.20
2/01 - 3/01 1978	1380000	23,903.73	4120	3540	3,536.00	49,220.54	2/13/79	8:30	23432.40
1/03 - 2/01 1977	1440000	24,850.68	4120	3640	3,626.00	49,020.18	1/24/79	11:00	22123.37
12/01 - 1/03 1977	1470000	25,277.67	4120	3660	3,644.00	47,337.90	1/03/79	8:30	20036.10
11/02 - 12/1 1977	1200000	20,443.08	4120	2840	2,906.00	38,444.52	11/21/79	10:30	16356.00
10/03 - 11/2 1977	1110000	19,564.98	4120	3040	3,086.00	36,660.64	10/31/79	9:00	15129.30
9/01 - 10/3 1977	1290000	21,755.04	4120	2920	2,978.00	39,617.25	9/06/79	12:00	16063.73
8/01 - 9/01 1977	1350000	22,980.90	4120	3200	3,230.00	39,153.36	8/17/79	14:00	14161.50
7/01 - 8/01 1977	1260000	21,575.97	4120	3060	3,104.00	36,735.37	7/29/79	12:15	13217.40

EDWARDS AIR FORCE BASE

Meter No. P714-002203
Schedule A7

Table 4. HOUSING--ELECTRIC

Date	Wherry KWH	Capehart KWH	Trailer Park KWH	Other KWH	Total KWH	KWH Cost	Peak Demand KW	Demand Cost	Total Cost
6/21 - 7/23 1979	408772	348164	58223	96841	912000				\$33,442.48
5/21 - 6/21 1979	380245	323866	51806	90083	846000	\$22287.96	1960	\$8428	29,993.61
4/23 - 5/21 1979	257750	219533	43654	61063	582000	15721.32	1780	7654	22,694.66
3/22 - 4/23 1979	348192	296566	46752	82490	774000	20433.24	1840	7912.00	27,612.15
2/22 - 3/22 1979	321977	274238	53506	76279	726000	19376.76	1960	8428.00	27,036.00
1/23 - 2/22 1979	373141	317815	70644	88400	850000	22529.00	2120	9116.00	33,815.44
12/21 - 1/23 1978	432632	368486	60388	102494	964000	27482.41	2120	6829.99	33,375.08
11/20 - 12/21 1978	401217	341729	56003	95051	894000	29797.86	2120	2258.00	30,986.39
10/23 - 11/20 1978	329411	280569	45980	78040	734000	24872.13	1980	2129.00	26,060.53
9/21 - 10/23 1978	377880	321852	52745	89523	842000	28050.57	1980	2129.00	29,207.78
8/22 - 9/21 1978	345489	294263	96248		736000	25339.28	2120	2258.00	26,680.00
7/24 - 8/22 1978	397332	338420	96248		832000	28403.50	1980	2128.99	29,650.45
6/22 - 7/24 1978	399492	340260	96248		836000	28500.99	1980	2129.00	28,436.70
5/23 - 6/22 1978	366010	311742	96248		774000	26629.83	1980	2129.00	27,936.78
4/24 - 5/23 1978	319567	272185	96248		688000	23913.74	1840	1982.00	25,097.85
3/23 - 4/24 1978	381131	324621	96248		802000	27587.15	1980	2129.00	28,813.11
2/22 - 3/23 1978	356289	303463	96248		756000	26199.99	1980	2129.00	27,447.84
1/23 - 2/22 1978	384371	327381	96248		808000	27932.10	2080	2222.00	29,227.58
12/21 - 1/23 1977	477257	406495	96248		980000	30524.75	2120	2258.00	31,751.69
11/22 - 12/21 1977	377891	321861	96248		796000	24901.54	2080	2222.00	26,197.15
10/20 - 11/22 1977	421093	358659	96248		876000	26904.99	1980	2129.00	28,095.08
9/20 - 10/20 1977		M I S S I N G			742000	23072.74	1840	1982.00	24,236.34
8/22 - 9/20 1977	330222	394028	83750		808000	23322.17	2120	2258.00	24,734.73
7/22 - 8/22 1977	384366	458634	85000		928000	25347.63	1980	2129.00	26,632.47
6/21 - 7/22 1977	361740	431635	86625		880000	24025.71	1980	2129.00	25,511.89

air conditioning requirements peak. Late afternoon, consumption drops peaking to a lesser degree during second shift hours and then declining in the late night and early morning hours.

Energy consumed is represented by the area under the curve: energy storage would have as its goal the smoothing out of this pattern, in an attempt to flatten the peaks by shifting demand to the valleys of the pattern. Neglecting losses in storage, the pattern indicates that as much as 3 or 4 megawatts (and corresponding demand charges) could be eliminated through energy storage load shifting.

In the appendix are utility supplied curves for each day in 1978 during which the peak demand for the month was recorded. The "M" points represent main base demand and "R" is rocket test area demand. The curves indicate that the potential for load leveling is good throughout the year but is a maximum in the summer months.

NATURAL GAS

Primary use of natural gas is for winter space heating and year-round domestic hot water needs. The monthly demand figures presented in Tables 5 and 6 for the six gas meters shown all follow the pattern of high winter demand, moderate spring and fall demand and relatively low demand in the summer months.

Substitution of solar energy for natural gas in space heating and hot water generation will be considered in the applications phase of this study. The utility costs of nearly \$850,000 for the last 12 months for the base family housing needs and over \$960,000 for main base facilities offer attractive incentives for study. Energy storage would be a necessary adjunct to the substitution of solar energy for natural gas.

Figure 3 presents the data of Tables 2 and 3 graphically. The bars represent the monthly gas consumption for main base facilities and family housing. Summer demand for gas in the main base facilities is minimal; the housing domestic hot water needs result in a greater demand for gas than in all other base facilities. Space heating needs turn this around, with main base consumption running as much as 40 percent above the housing demand.

EDWARDS AIR FORCE BASE

Table 5. MAIN BASE NATURAL GAS

DATE	51129 MAIN BASE		51139 LARGE PLANTS		51149 SMALL PLANTS		RATE SCHEDULE - G2	
	Cu.Ft.	\$ Cost	Cu.Ft.	\$ Cost	Cu.Ft.	\$ Cost	TOTAL BILLING	
							Cu.Ft.	\$ Cost
6/1- 7/1 1979	3397111	9,666.53	1636967	4,658.01	1636967	4,658.01	6671045	18,982.55
5/1- 6/1 1979	5307960	14,566.88	1842521	5,056.52	1842521	5,056.52	8993002	24,679.92
4/1- 5/1 1979	14212196	38,966.09	4933395	13,526.07	4933395	13,526.07	24108986	66,018.23
3/1- 4/1 1979	23978788	65,682.44	8323613	22,799.95	8323613	22,799.95	40626015	111,282.34
2/1- 3/1 1979	30956494	85,108.39	10745742	29,543.16	10745742	29,543.16	52447978	144,194.71
1/1- 2/1 1979	38818411	106,722.89	13474802	37,046.08	13474802	37,046.08	65768015	180,815.05
12/1- 1/1 1978	37105525	102,201.24	12880219	35,476.50	12880219	35,476.50	62865963	173,154.24
11/1-12/1 1978	25689849	70,693.88	8917564	24,539.55	8917564	24,539.55	43524977	119,772.98
10/1-11/1 1978	7485354	20,588.50	2601817	7,146.76	2601817	7,146.76	12698988	34,882.02
	<u>50928</u>		<u>50938</u>		<u>50948</u>		RATE SCHEDULE - G1WN	
9/1-10/1 1978	4527087	11,847.63	1571461	4,112.59	1571461	4,112.59	7670009	20,072.81
8/1- 9/1 1978	3780428	8,975.29	1312277	3,115.54	1312277	3,115.54	6404982	15,206.37
7/1- 8/1 1978	3629928	8,633.91	1260036	2,997.04	1260036	2,997.04	6150000	14,627.99
6/1- 7/1 1978	3649375	8,648.26	1266785	3,002.02	1266785	3,002.02	6182945	14,652.80
5/1- 6/1 1978	6613562	15,599.66	2295726	5,415.01	2295726	5,415.01	11205014	26,429.68
4/1- 5/1 1978	19467046	45,958.89	6757479	15,953.44	6757479	15,953.44	32982004	77,365.77
3/1- 4/1 1978	21891720	51,779.01	7599140	17,973.73	7599140	17,973.73	37090000	87,726.47
2/1- 3/1 1978	26729875	63,222.20	9278581	21,945.95	9278581	21,945.95	45287037	107,114.10
1/1- 2/1 1978	31697835	74,764.17	11003079	25,952.44	11003079	25,952.44	53703993	126,669.05
12/1- 1/1 1977	27620517	65,147.29	9587745	22,614.19	9587745	22,614.19	46796007	110,375.67
11/1-12/1 1977	22103022	52,133.57	7672489	18,096.81	7672489	18,096.81	3744800	88,327.19
10/1-11/1 1977	8947911	21,105.53	3106035	7,326.23	3106035	7,326.23	15159981	35,757.99
	<u>50887</u>		<u>50877</u>		<u>50907</u>			
9/1-10/1 1977	4193599	9,928.60	1445698	3,446.45	1445698	3,446.45	7104995	16,821.50
8/1- 9/1 1977	3823515	9,052.45	1327234	3,142.33	1327734	3,142.33	6477983	15,337.11
7/1- 8/1 1977	3887195	9,115.34	1349339	3,164.15	1349339	3,164.15	6585873	15,443.64

EDWARDS AIR FORCE BASE

Table 6. FAMILY HOUSING--NATURAL GAS

RATE SCHEDULE - G2

Date	51169 CAPEHART		51159 WHERRY		51209 TRAILER PARK		TOTAL BILLING	
	Cu.Ft.	\$ Cost	Cu.Ft.	\$ Cost	Cu.Ft.	\$ Cost	Cu.Ft.	\$ Cost
6/1- 7/1 1979	5298516	18,805.93	5143975	18,257.43	596083	2,115.67	11038575	37,238.93
5/1- 6/1 1979	6969989	21,542.56	6766697	20,914.24	784124	2,423.54	14520810	44,880.34
4/1- 5/1 1979	10016560	30,521.21	9724411	29,633.92	1126863	3,433.98	20867834	63,592.11
3/1- 4/1 1979	13135528	39,702.96	12752408	38,544.95	1477747	4,466.58	27365683	82,714.49
2/1- 3/1 1979	15853323	47,897.54	15390935	46,500.52	1783499	5,388.47	33027757	99,786.53
1/1- 2/1 1979	19739162	59,409.39	19163436	57,676.61	2220656	6,683.56	41123254	123,769.56
12/1- 1/1 1978	19517680	58,859.54	18948415	57,142.80	2195739	6,621.70	40661834	122,624.04
11/1-12/1 1978	14496396	43,956.56	14073585	42,674.50	1630845	4,945.11	30200826	91,576.17
10/1-11/1 1978	7407088	22,875.44	7191048	22,208.23	833298	2,573.47	15431434	47,657.16
	50898		50888		50908			
9/1-10/1 1978	5401059	16,191.90	5243528	15,719.63	607619	1,821.59	11252206	33,733.12
8/1- 9/1 1978	5268753	13,439.63	5115080	13,047.64	592735	1,511.96	10976568	27,999.23
7/1- 8/1 1978	5302807	13,543.70	5148142	13,148.67	596565	1,523.67	11047514	28,216.04
6/1- 7/1 1978	5524613	14,022.84	5363479	13,613.84	621519	1,577.57	11509611	29,214.25
5/1- 6/1 1978	7298585	18,146.49	7085709	17,617.21	821091	2,041.48	15205385	37,805.18
4/1- 5/1 1978	11650241	29,367.20	11310442	28,510.65	1310652	3,303.81	24271335	61,181.66
3/1- 4/1 1978	12011244	29,411.77	11690042	28,553.93	1354640	3,308.83	25085926	61,274.53
2/1- 3/1 1978	14339022	33,915.23	13920801	32,926.04	1613140	3,815.46	29872963	70,656.73
1/1- 2/1 1978	17378095	41,920.32	16871234	40,697.65	1955035	4,716.03	36204364	87,334.00
12/1- 1/1 1977	14302262	34,665.57	13885113	33,654.49	1609004	3,899.87	29796379	72,219.93
11/1-12/1 1977	14009404	33,974.82	13600796	32,983.89	1576058	3,822.17	29186258	70,780.88
10/1-11/1 1977	7375644	18,328.24	7160520	17,793.66	829760	2,061.93	15365924	38,183.83
	50857		58067		50847			
9/1-10/1 1977	3515370	8,958.48	5602902	14,278.30	1608000	4,097.79	10726272	27,334.57
8/1- 9/1 1977	3655638	9,294.23	5826464	14,813.43	1608000	4,088.24	11090102	28,195.90
7/1- 8/1 1977	3662927	9,062.23	5838082	14,443.64	1644000	4,067.32	11145009	27,573.19

APPENDIX

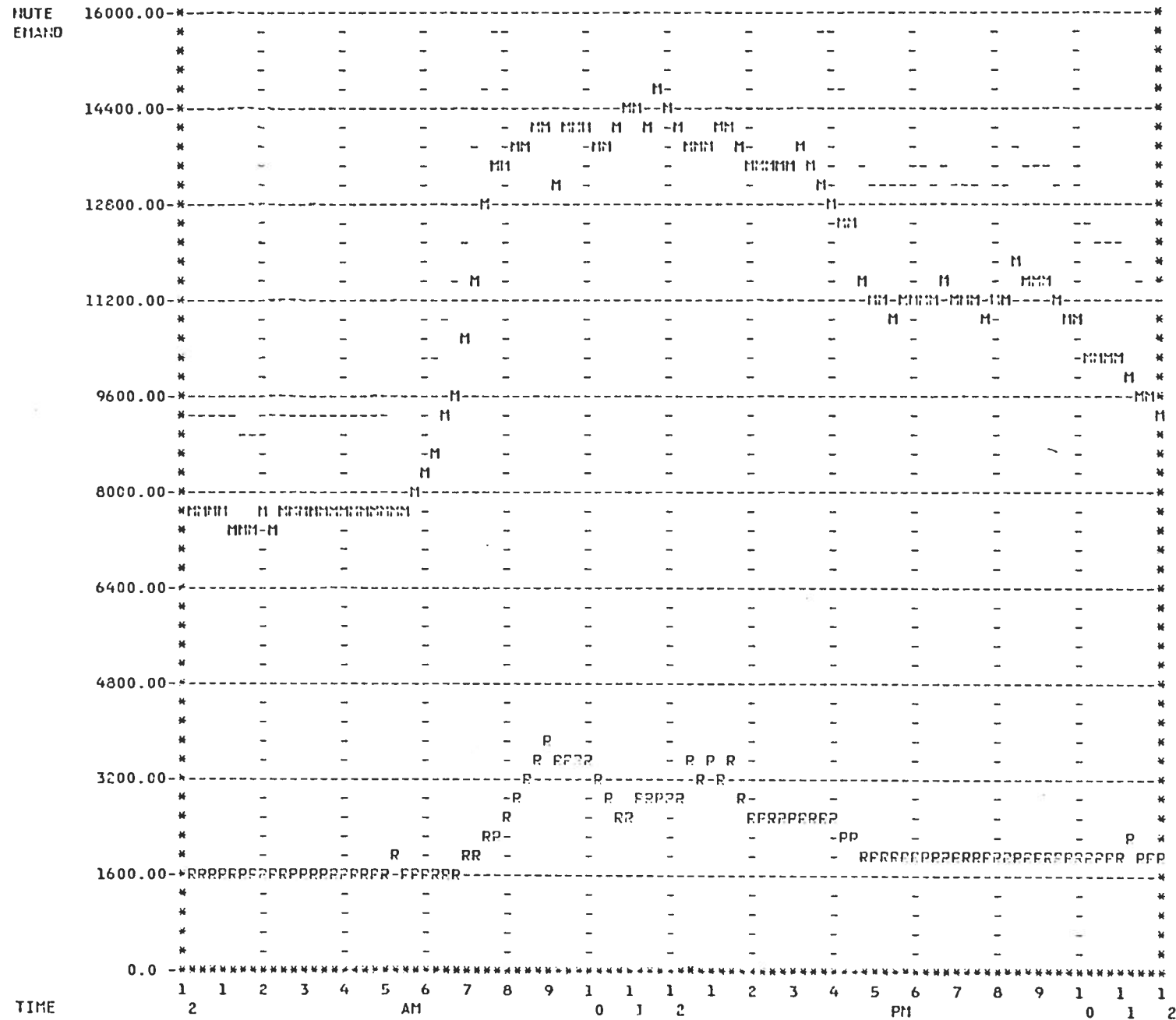
- PEAK DEMAND CURVES 1978
- RATE SCHEDULES

TOU-8

A-7

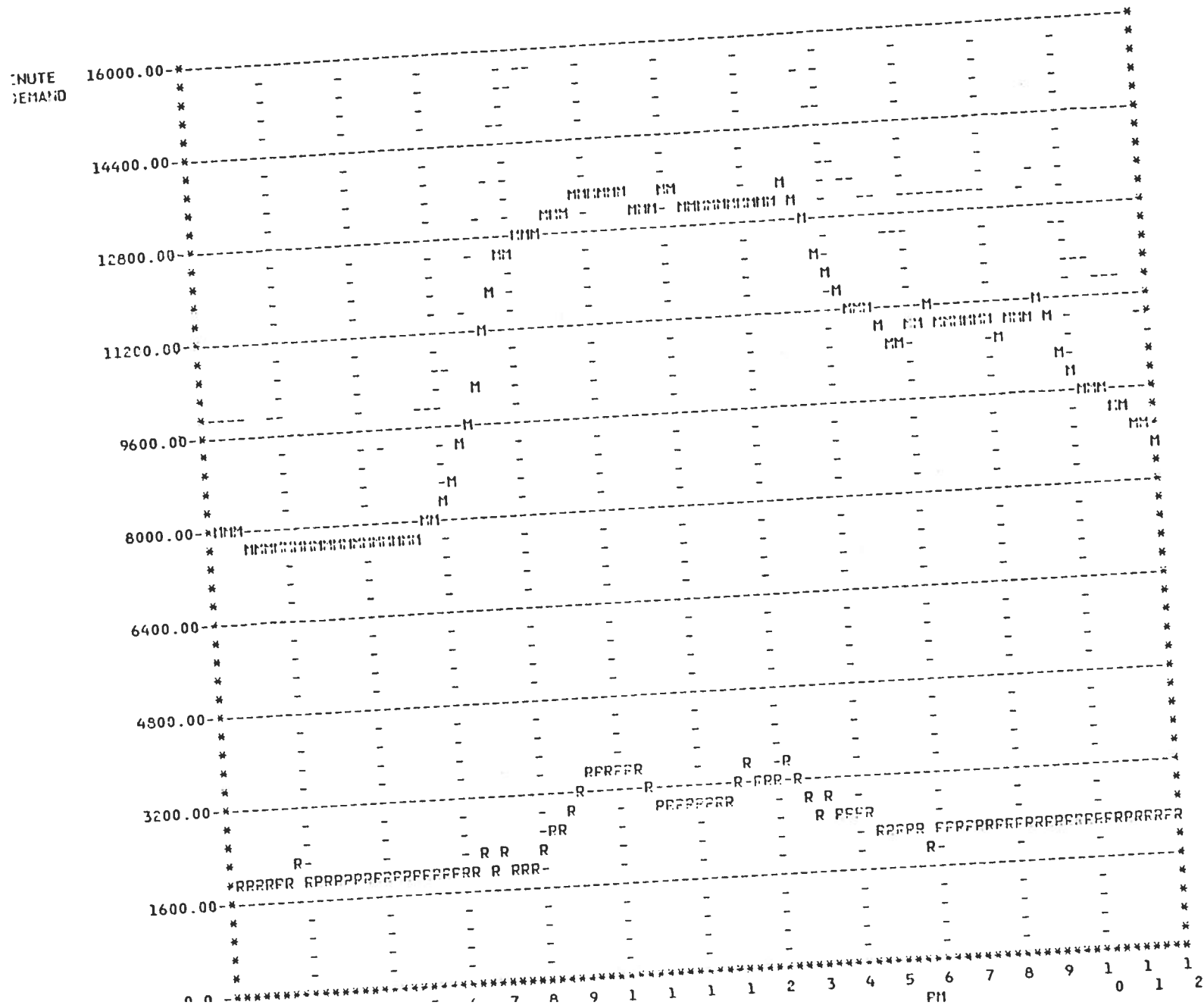
ORCE BASE

PROGRAM P796A RUN ON 05/10/79 AT 02:14
FIFTEEN MINUTE AVERAGE DIVERSIFIED DEMANDS
TUESDAY 1/ 3/78



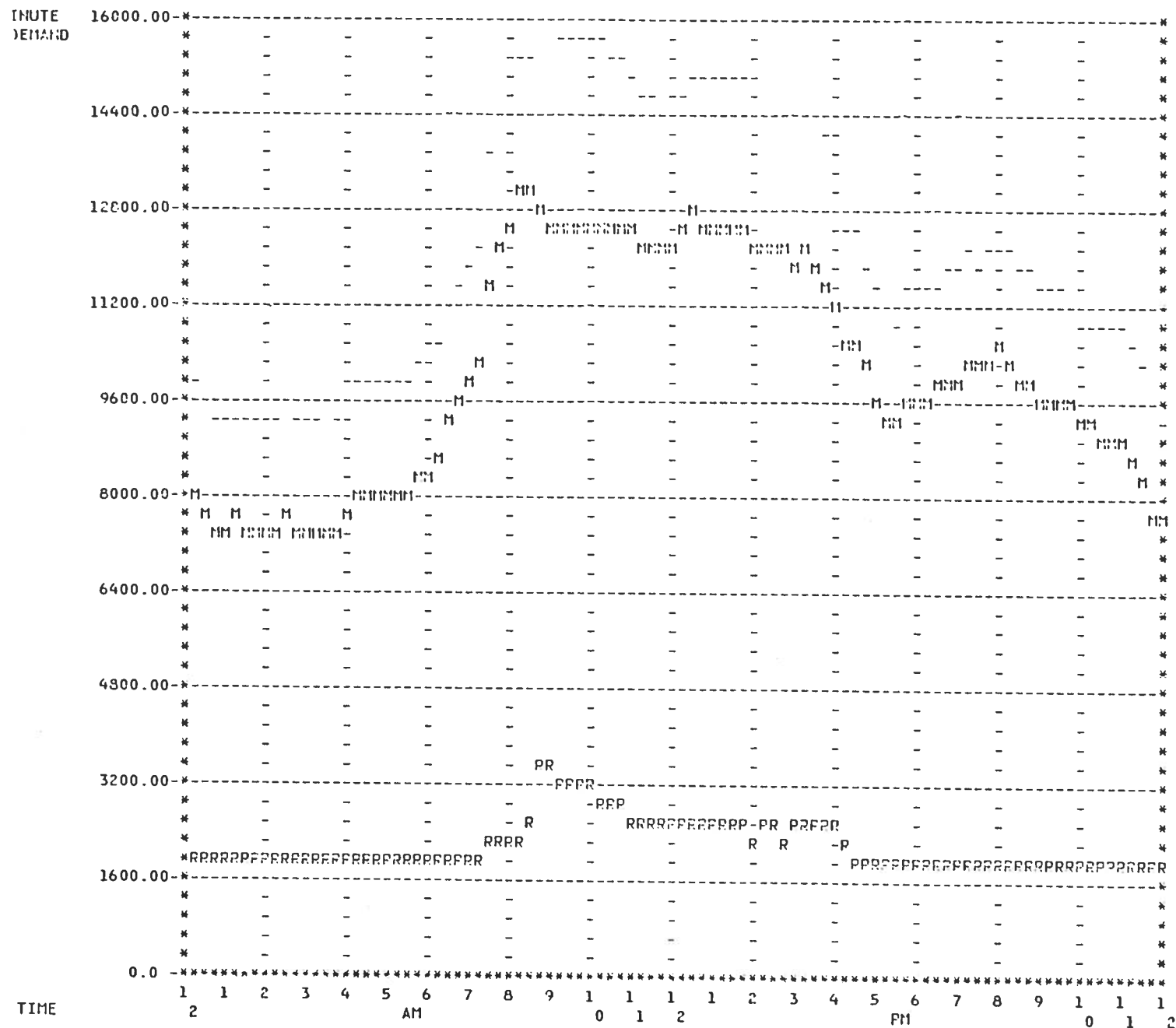
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 FRIDAY 2/10/78

ORCE BASE



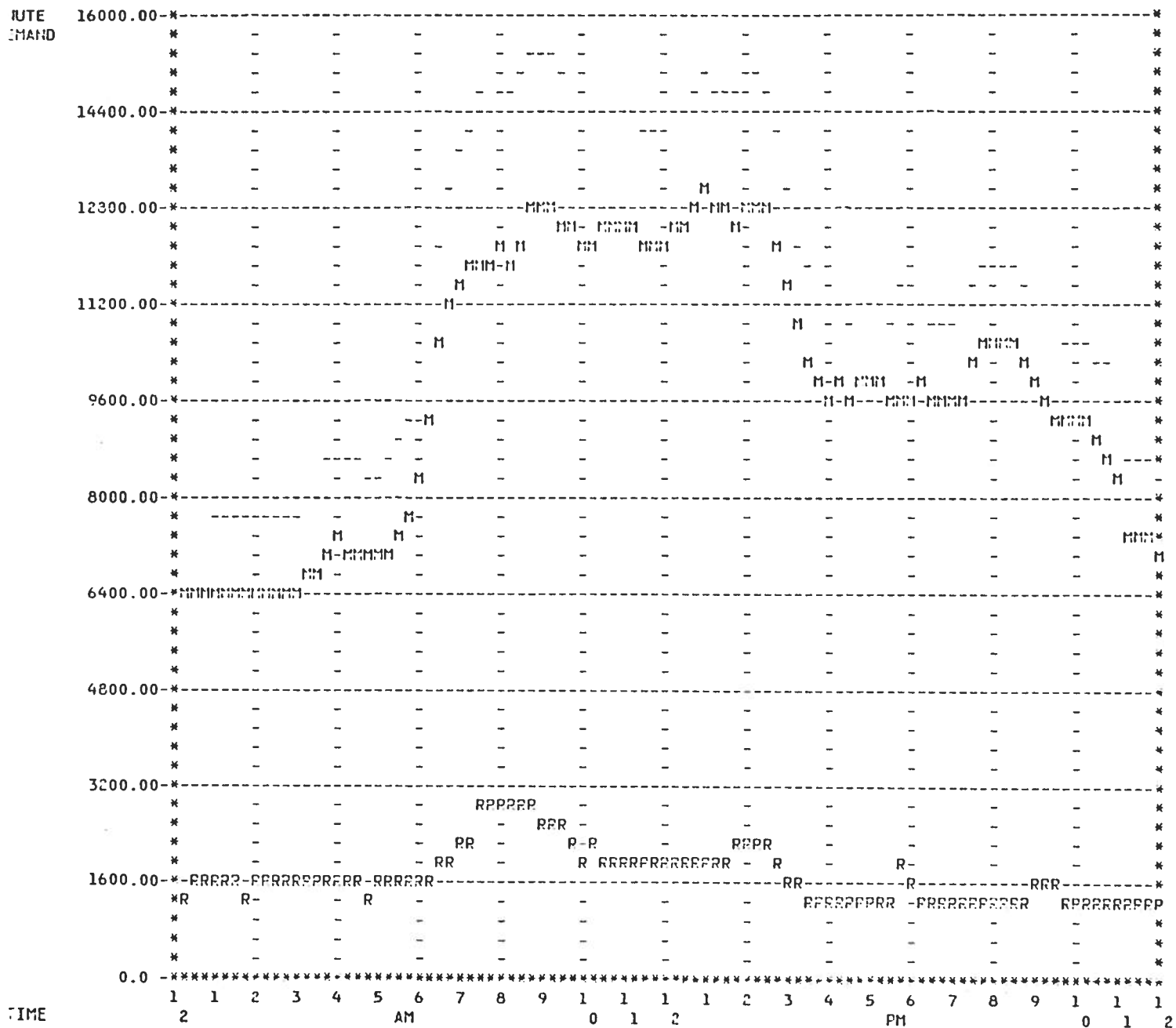
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FRIDAY 4/ 7/78



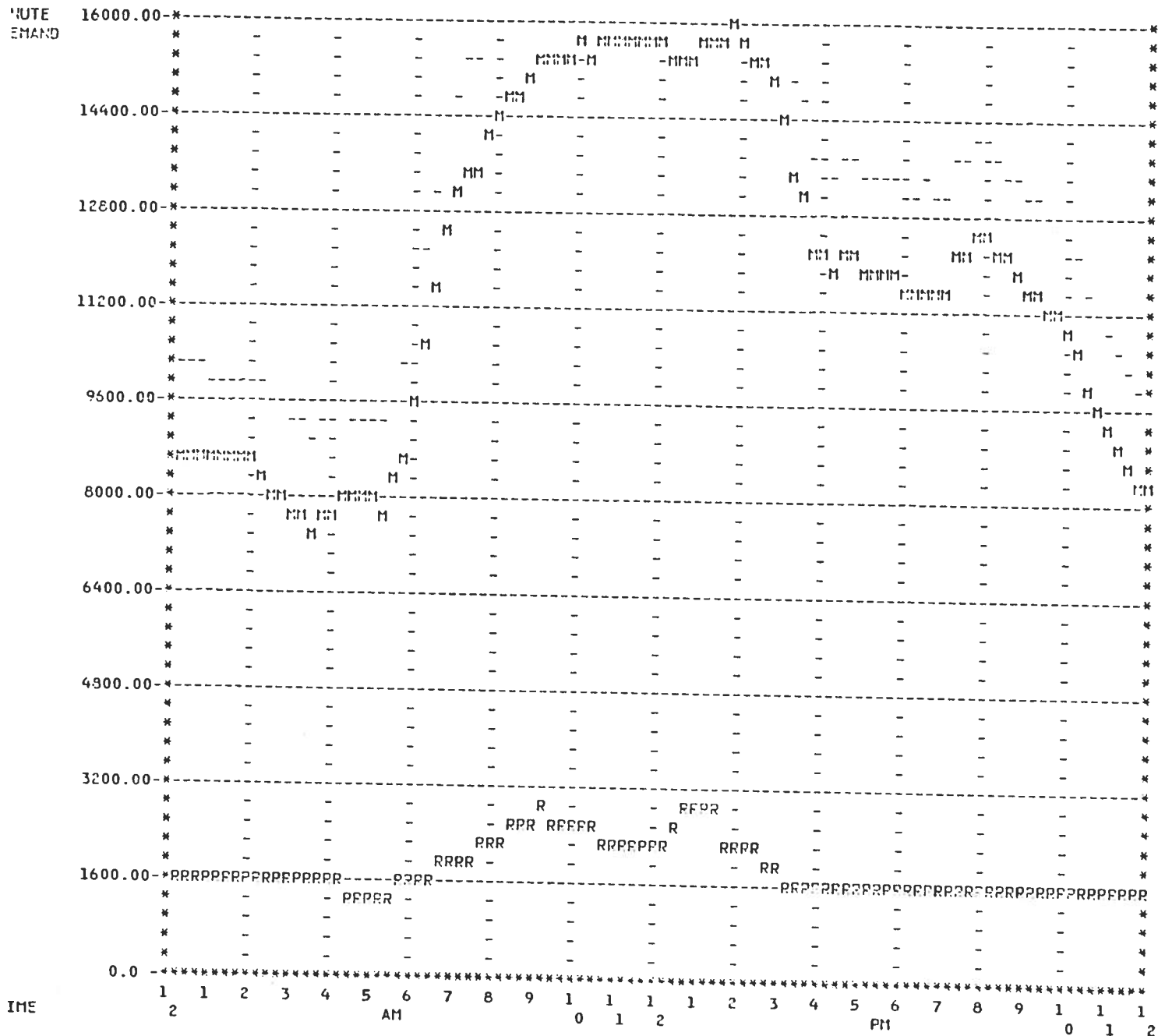
PRICE BASE

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TUESDAY 5/16/78



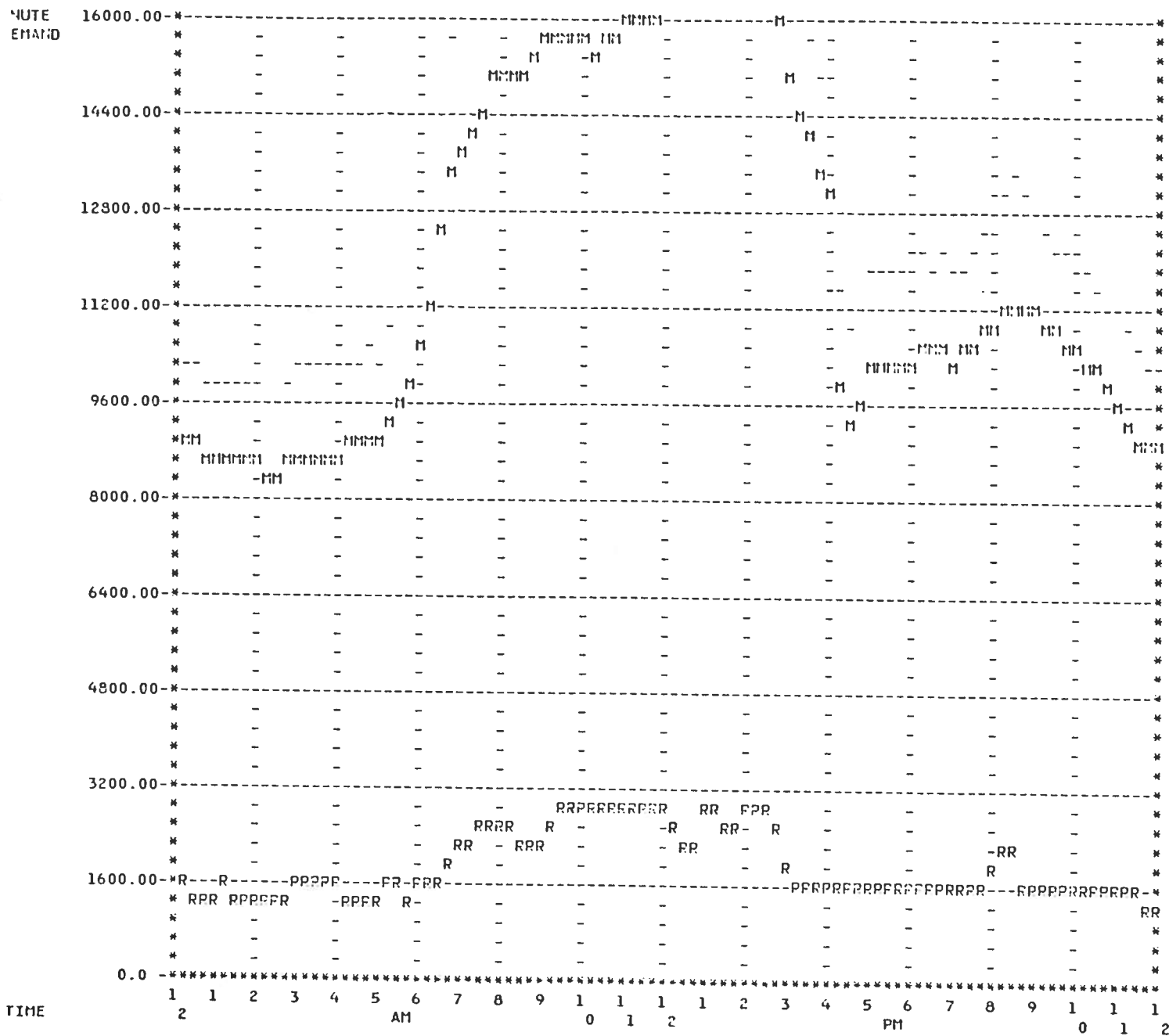
RCE BASE

PROGRAM P796A RUN ON 05/10/79 AT 02:14
FIFTEEN MINUTE AVERAGE DIVERSIFIED DEMANDS
FRIDAY 6/ 9/78



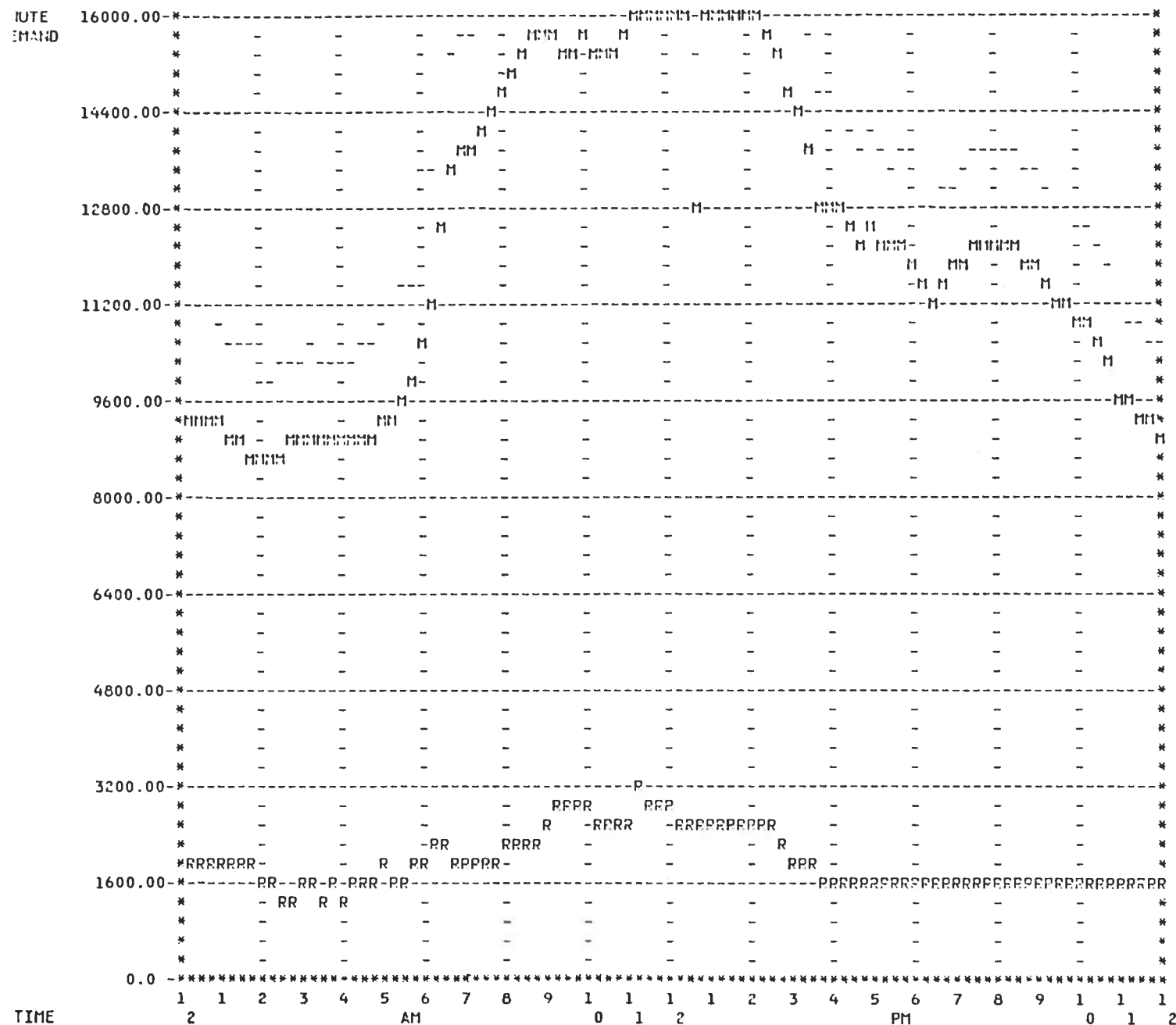
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FIFTEEN MINUTE AVERAGE DIVERSIFIED DEMANDS
MONDAY 7/24/78



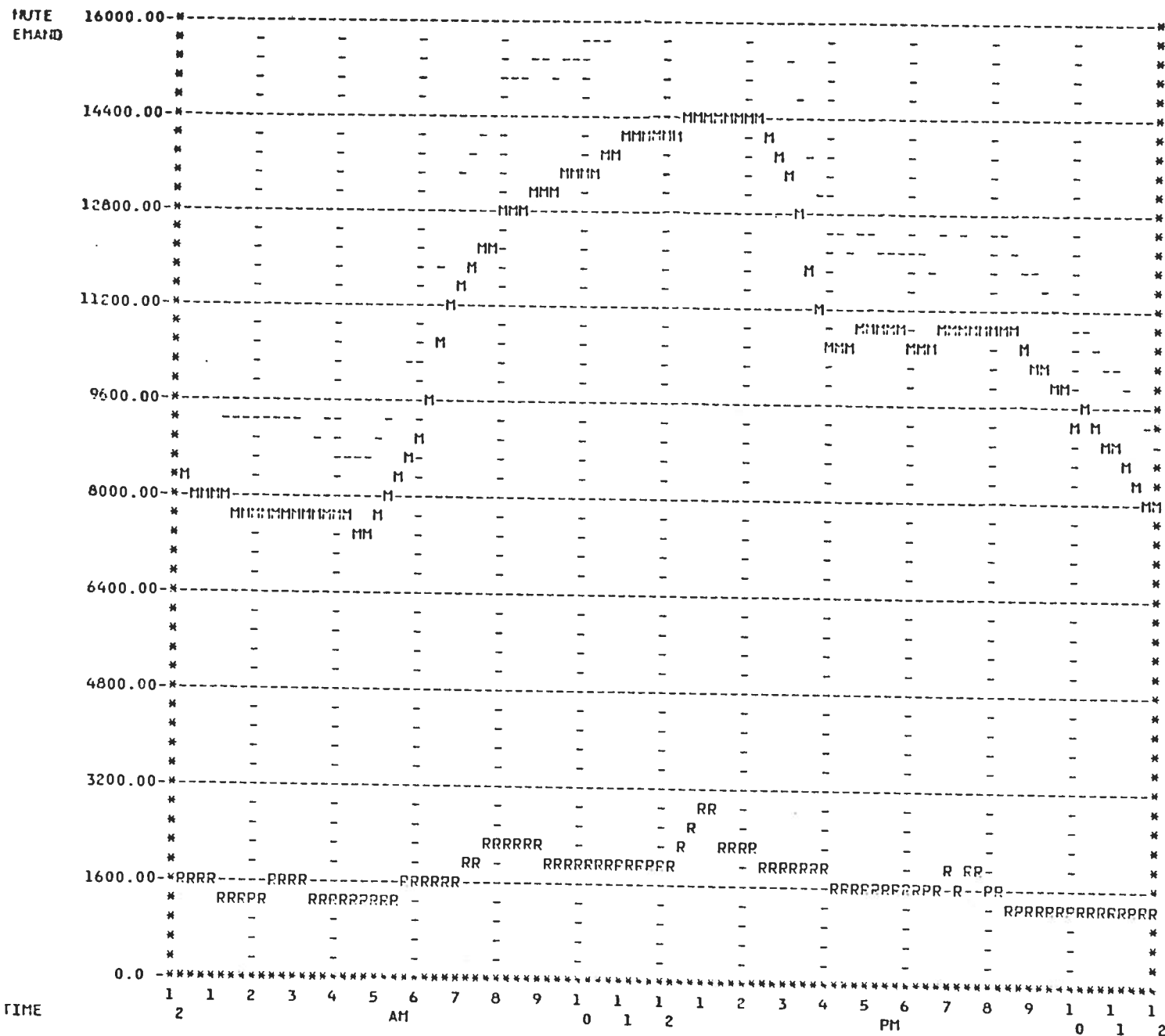
RCE BASE

PROGRAM P796A RUN ON 05/10/79 AT 02:14
FIFTEEN MINUTE AVERAGE DIVERSIFIED DEMANDS
TUESDAY 8/ 1/78



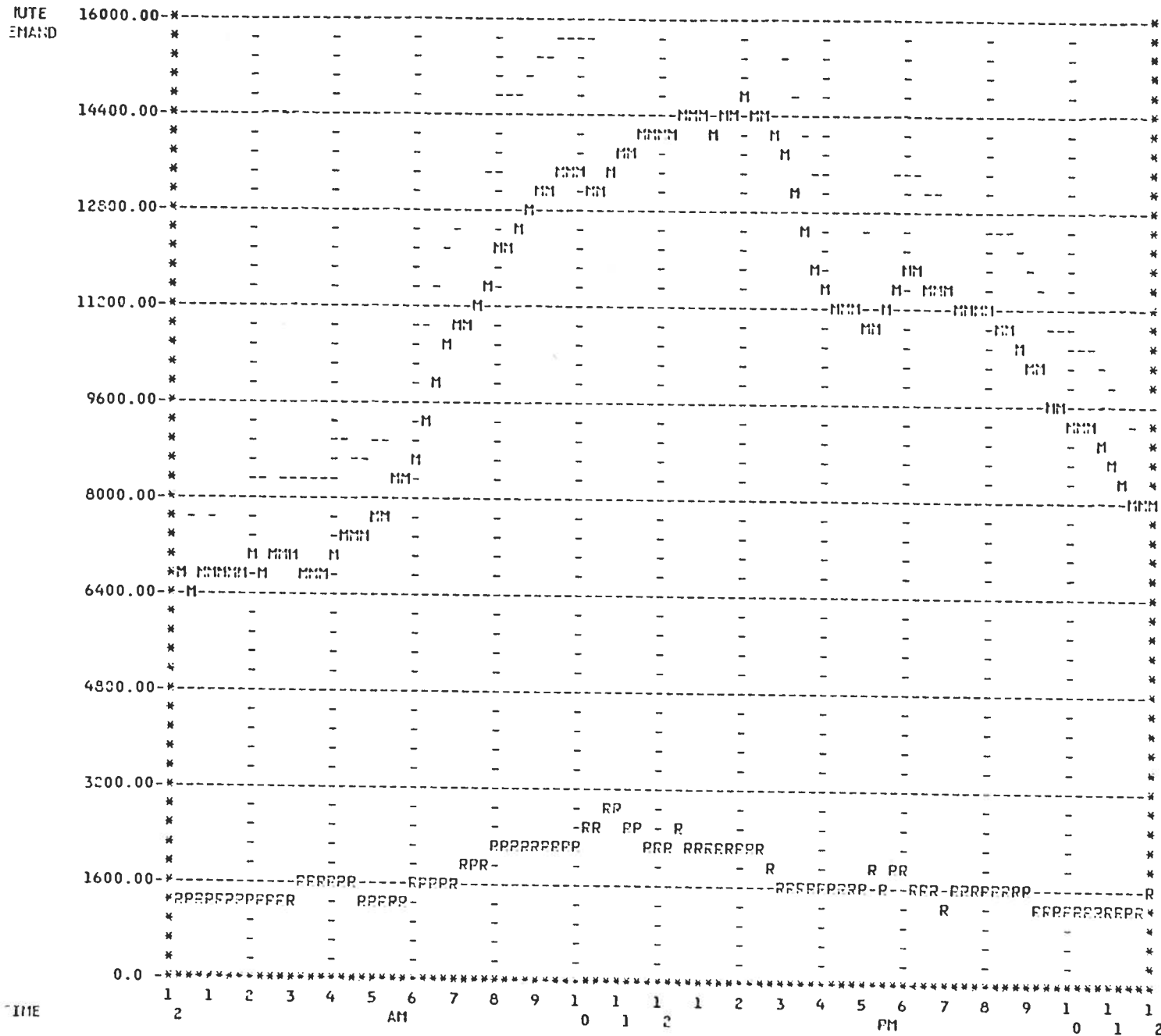
RCE BASE

PROGRAM P796A RUN ON 05/10/79 AT 02:14
FIFTEEN MINUTE AVERAGE DIVERSIFIED DEMANDS
FRIDAY 9/ 1/78



RCE BASE

PROGRAM P796A RUN ON 05/10/79 AT 02:14
FIFTEEN MINUTE AVERAGE DIVERSIFIED DEMANDS
WEDNESDAY 10/ 4/78



SOUTHERN CALIFORNIA EDISON COMPANY
2244 Walnut Grove Avenue
Rosemead, California 91770

Revised Cal. P.U.C. Sheet No. 4852-E

Cancelling Revised Cal. P.U.C. Sheet No. 4757-E

Schedule No. TOU-8

GENERAL SERVICE — LARGE

APPLICABILITY

Applicable to three-phase general service, including lighting and power, supplied directly from lines of transmission voltage or where for the Company's operating convenience service is supplied from lines of distribution voltage.

This schedule is applicable for all customers of record on August 23, 1977, served on Schedule No. A-8 and thereafter is applicable to all customers whose monthly maximum demand exceeds 5,000 kW for any three months during the preceding 12 months. Any customer whose monthly maximum demand has fallen below 4,500 kW for 12 consecutive months may elect to take service on any other applicable schedule.

TERRITORY

Within the entire territory served, excluding Santa Catalina Island.

RATES

	Per Meter	Per Month
Customer Charge:	\$ 800.00	\$1075.00
Demand Charge (to be added to Customer Charge):		
All kW of on-peak billing demand, per kW:	\$ 2.10	\$5.05
Plus all kW of mid-peak billing demand, per kW:	0.25	\$0.65
Plus all kW of off-peak billing demand, per kW:	No Charge	
Energy Charge (to be added to Demand Charge):		
All on-peak kWh, per kWh:	1.408¢	\$0.0053
Plus all mid-peak kWh, per kWh:	1.258¢	\$0.0038
Plus all off-peak kWh, per kWh:	1.108¢	\$0.0023

Minimum Charge:

The monthly minimum charge shall be the sum of the monthly Customer and Demand Charges. The monthly Demand Charge shall be not less than the charge for 25% of the maximum on-peak demand established during the preceding 11 months.

Daily time periods will be based on Pacific Standard Time and are defined as follows:

On-peak: 12:00 noon to 6:00 p.m. summer weekdays except holidays
5:00 p.m. to 10:00 p.m. winter weekdays except holidays

Mid-peak: 8:00 a.m. to 12:00 noon and 6:00 p.m. to 10:00 p.m. summer weekdays except holidays
8:00 a.m. to 5:00 p.m. winter weekdays except holidays

Off-peak: All other hours.

Off-peak holidays are New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, and Christmas.

For initial implementation of this schedule by the Company, winter shall consist of the billing periods for the six regularly scheduled monthly billings beginning with the first regularly scheduled billing ending after November 14, 1977. Thereafter, regularly scheduled monthly billings shall include six summer billing periods followed by six winter billing periods. In no event will winter include scheduled billing periods ending after May 31 of any year.

(Continued)

(To be inserted by utility)
Advice Letter No. 446-E

Issued by
Edward A. Myers, Jr.
Name

(To be inserted by Cal. P.U.C.)
Date Filed September 14, 1977

Decision No. 87744

Vice President
Title

Effective October 14, 1977

Resolution No.

*effective July 22, 1979

Schedule No. TOU-8

GENERAL SERVICE — LARGE

(Continued)

SPECIAL CONDITIONS

1. **Voltage:** Service will be supplied at one standard voltage.
2. **Maximum Demand:** Maximum demands shall be established for the daily on-peak, mid-peak, and off-peak periods. The maximum demand for each period shall be the measured maximum average kilowatt input indicated or recorded by instruments to be supplied by the Company, during any 15-minute metered interval, but not less than the diversified resistance welder load computed in accordance with the section designated Welder Service in Rule No. 2. Where the demand is intermittent or subject to violent fluctuations, a 5-minute interval may be used.
3. **Billing Demand:** Separate billing demands for the on-peak, mid-peak, and off-peak daily time periods shall be established for each monthly billing period. The billing demand for each daily time period shall be the maximum demand for that daily time period occurring during the respective monthly billing period.
4. **Voltage Discount:** The charges before power factor adjustment will be reduced by 1% for service delivered and metered at a nominal voltage of 33,000 volts, and by 2% for service delivered and metered at a nominal voltage of 66,000 volts or over.
5. **Power Factor Adjustment:** The charges will be adjusted each month for reactive demand. The charges will be increased by 20 cents per kilovar of maximum reactive demand imposed on the Company in excess of 20% of the maximum number of kilowatts.

The maximum reactive demand shall be the highest measured maximum average kilovar demand indicated or recorded by metering to be supplied by the Company during any 15-minute metered interval in the month. The kilovars shall be determined to the nearest unit. A device will be installed on each kilovar meter to prevent reverse operation of the meter.
6. **Temporary Discontinuance of Service:** Where the use of energy is seasonal or intermittent, no adjustments will be made for a temporary discontinuance of service. Any customer prior to resuming service within twelve months after such service was discontinued will be required to pay all charges which would have been billed if service had not been discontinued.
7. **Contracts:** An initial three-year facilities contract may be required where applicant requires new or added serving capacity exceeding 2,000 kVA.
8. **Energy Cost Adjustment:** The rates above are subject to adjustment as provided for in Part G of the Preliminary Statement. The applicable energy cost adjustment billing factors and fuel collection balance adjustment billing factor set forth therein will be applied to all kWh billed under this schedule. The energy cost adjustments will be applied after all other discounts or adjustments.

(To be inserted by utility)

Advice Letter No. 446-E

Issued by

Edward A. Myers, Jr.

Name

(To be inserted by Cal. P.U.C.)

Date Filed September 14, 1977

Decision No. 87744

Vice President

Title

Effective October 14, 1977

Resolution No.

Schedule No. A-7

GENERAL SERVICE

APPLICABILITY

Applicable to single- and three-phase general service including lighting and power.

TERRITORY

Within the entire territory served, excluding Santa Catalina Island.

RATES

Demand Charge:		Per Meter Per Month
First	200 kw or less of billing demand.....	\$260.00
Next	1,800 kw of billing demand, per kw.....	1.05
Next	8,000 kw of billing demand, per kw.....	0.90
All excess	kw of billing demand, per kw.....	0.75
Energy Charge (to be added to Demand Charge):		
First 150 kwhr per kw of billing demand:		
	First 30,000 kwhr, per kwhr.....	2.690¢
	Balance of kwhr, per kwhr.....	2.015¢
	Next 150 kwhr per kw of billing demand, per kwhr.....	1.658¢
	All excess kwhr, per kwhr.....	1.320¢

Minimum Charge:

The monthly minimum charge shall be the monthly Demand Charge.

SPECIAL CONDITIONS

- 1. Voltage:** Service will be supplied at one standard voltage.
- 2. Billing Demand:** The billing demand shall be the kilowatts of maximum demand but not less than 50% of the highest maximum demand established in the preceding 11 months, however, in no case shall the billing demand be less than 200 kw. Billing demand shall be determined to the nearest kw.
- 3. Maximum Demand:** The maximum demand in any month shall be the measured maximum average kilowatt input, indicated or recorded by instruments to be supplied by the Company, during any 15-minute metered interval in the month, but not less than the diversified resistance welder load computed in accordance with the section designated Welder Service in Rule No. 2. Whenever the measured maximum demand has exceeded 400 kw for three consecutive months and thereafter until it has fallen below 300 kw for 12 consecutive months, a 30-minute interval will be used. Where the demand is intermittent or subject to violent fluctuations, a 5-minute interval may be used.
- 4. Voltage Discount:** The charges before power factor adjustment will be reduced by 3% for service delivered and metered at voltages of from 2 kv to 10 kv; by 4% for service delivered and metered at voltages of from 11 kv to 50 kv; and by 5% for service delivered and metered at voltages over 50 kv; except that when only one transformation from a transmission voltage level is involved, a customer normally entitled to a 3% discount will be entitled to a 4% discount.

(Continued)

(To be inserted by utility)
Advice Letter No. 433-E
86087,
Decision No. 86760, 86794

Issued by
Edward A. Myers, Jr.
Name

Vice President
Title

(To be inserted by Cal. P.U.C.)
Date Filed January 11, 1977
Effective January 13, 1977
Resolution No. _____

Schedule No. A-7

GENERAL SERVICE

(Continued)

SPECIAL CONDITIONS (Continued)

5. Power Factor Adjustment: The charges will be adjusted each month for the power factor as follows:

The charges will be decreased by 20 cents per kilowatt of measured maximum demand and will be increased by 20 cents per kilovar of reactive demand. However, in no case shall the kilovars used for the adjustment be less than one-fifth the number of kilowatts.

The kilovars of reactive demand shall be calculated by multiplying the kilowatts of measured maximum demand by the ratio of the kilovar-hours to the kilowatt-hours. Demands in kilowatts and kilovars shall be determined to the nearest unit. A ratchet device will be installed on the kilovar-hour meter to prevent its reverse operation on leading power factors.

6. Temporary Discontinuance of Service: Where the use of energy is seasonal or intermittent, no adjustments will be made for a temporary discontinuance of service. Any customer prior to resuming service within twelve months after such service was discontinued will be required to pay all charges which would have been billed if service had not been discontinued.

7. Adjustment for Off-Peak Demand: Upon application by the customer, in any month when the maximum demand exceeds 500 kw, any kilowatts of maximum demand in excess of the on-peak demand will not be considered in establishing the billing demand for computing the energy charge, but will be considered in establishing the billing demand for computing the demand charge, by adding one-half of the amount that the maximum demand exceeds the on-peak demand, to the on-peak demand. The on-peak demand will be the maximum demand occurring between the hours of 6:30 a.m. and 10:30 p.m., Pacific Standard Time, of any day except Sundays and the following holidays: New Years, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas.

8. Contracts: An initial three-year contract may be required where applicant requires new or added serving capacity exceeding 2,000 kva.

9. Energy Cost Adjustment: The rates above are subject to adjustment as provided for in Part G of the Preliminary Statement. The applicable energy cost adjustment billing factors and fuel collection balance adjustment billing factor set forth therein will be applied to kwhr billed under this schedule.

(To be inserted by utility)

Advice Letter No. 429-E (Suppl.)

Issued by

Edward A. Myers, Jr.

Name

(To be inserted by Cal. P.U.C.)

Date Filed October 6, 1976

Decision No. _____

Effective October 13, 1976

Vice President

Title

Resolution No. E-1595, E-1604